

WAVES_2006 (Water Vapor Validation – Satellite/Sondes)

*An AURA satellite validation field campaign hosted at the
Howard University Research Campus in Beltsville, MD*

D. N. Whiteman¹, M. Adam², B. Bojkov⁵, C. Barnet¹³, B. Demoz¹, J. Fitzgibbon⁴,
R. Forno¹², R. Herman⁸, R. Hoff³, E. Joseph², E. Landulfo¹¹, K. McCann³, T.
McGee¹, L. Miloshevich⁵, I. Restrepo¹⁰, F. Schmidlin¹, B. Taubman⁷, A.
Thompson⁷, D. Venable², H. Vömel⁶, C. Walthall⁹

1 NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771

2 Howard University, Washington, DC 20059

3 University of Maryland, Baltimore County, Baltimore, Maryland 21250

4 NOAA/National Weather Service, Sterling, Virginia 20166

5 National Center for Atmospheric Research, Boulder, CO 80305

6 University of Colorado (CIRES), Boulder, CO 80309

7 Pennsylvania State University, University Park, PA 168027

8 Jet Propulsion Lab, Pasadena, CA 91109

9 U.S. Department of Agriculture, Beltsville, MD 20705

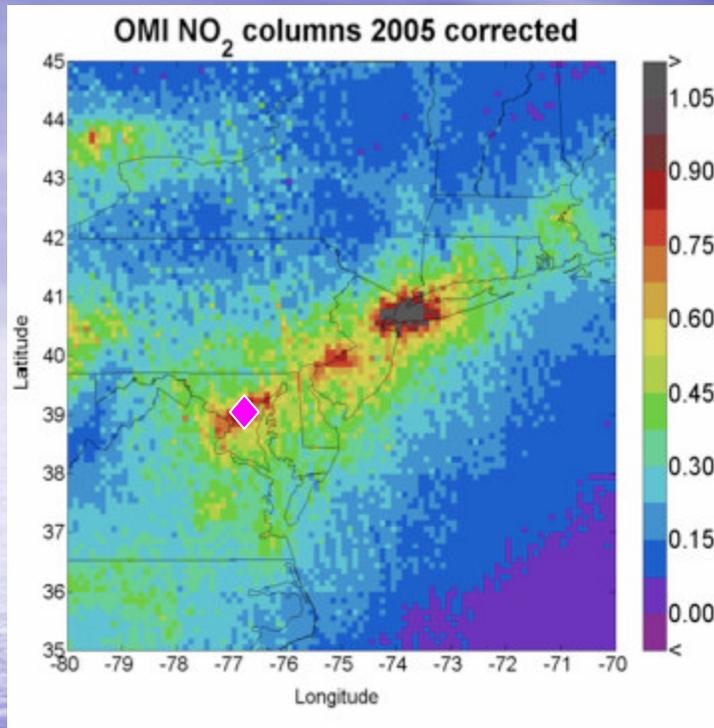
10 Trinity University, Washington, DC 20017

11 Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, Brazil

12 University Mayor de San Andrés, La Paz, Bolivia

13 NOAA/NESDIS Camp Springs, MD

The Howard University Beltsville Research Campus



- **A semi-urban field site**
 - Mid-Atlantic, urban experiences a wide range of meteorological conditions
 - A major pollution corridor.
 - High population pressure
- **Comprehensive set of Observation Systems**
 - IONS site for the past three years
- **Opportunities for inter-agency and university collaboration.**
 - Integrate Science and Education



Beltsville Campus Instrumentation

Aerosol-Cloud-Radiation



Atmosphere-Surface



Air Quality



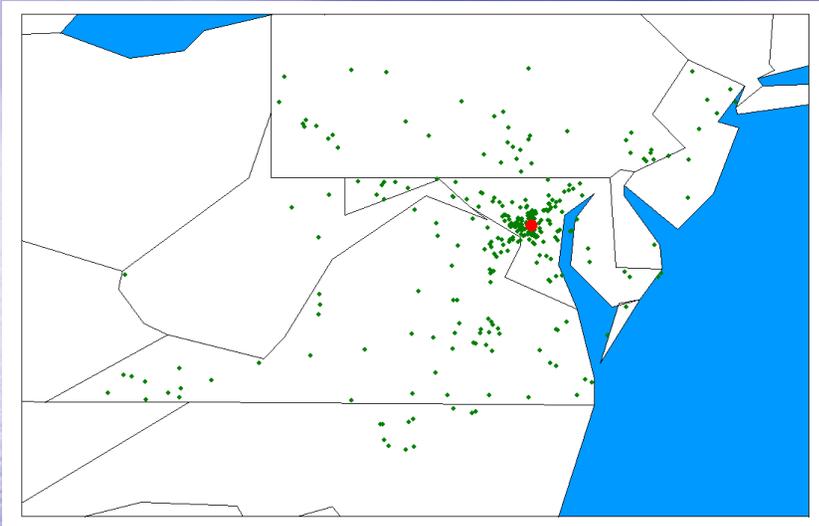
Integrating Research and Student Training



Student Theses Using WAVES Data

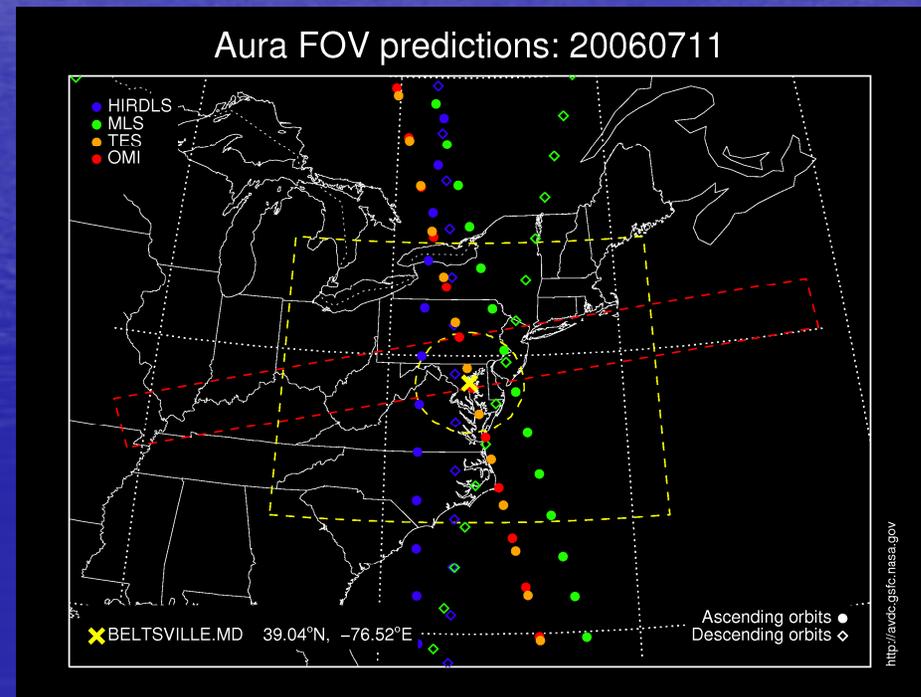
- Howard University
 - lidar cirrus cloud measurements (Connel)
 - Mesoscale convective studies using WRF (Walford)
 - Aerosol indirect effect (Nzeffe)
 - Model vs observed fluxes (Robjohn)
- UMBC
 - Aerosol hygroscopic growth (Rogers)
- Penn State
 - TDB but much data acquired by NATIVE during WAVES

WeatherBug Mesonet Centered on Beltsville



Pressure, Temperature, RH, winds,
rainfall at distributed sites (5 min).

Favorable location for Aura overpasses



WAVES_2006 Operations and Analysis Status

- Operations

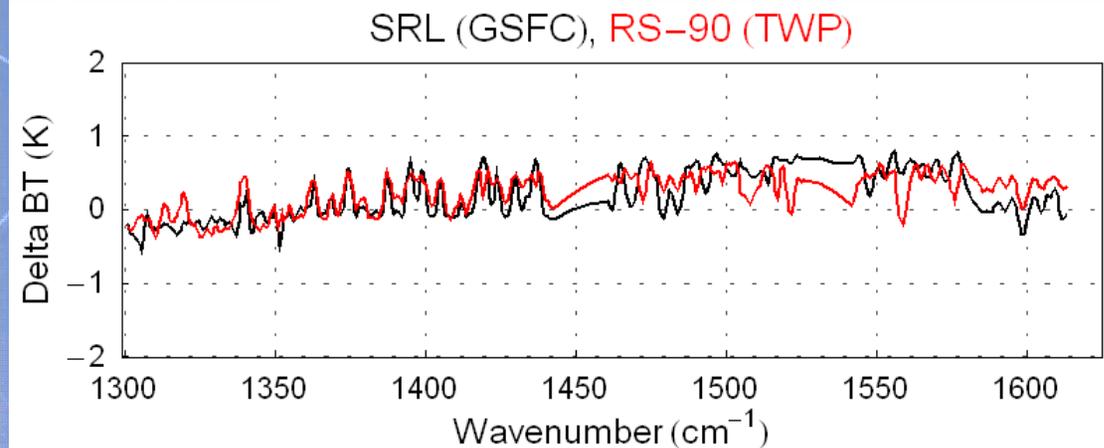
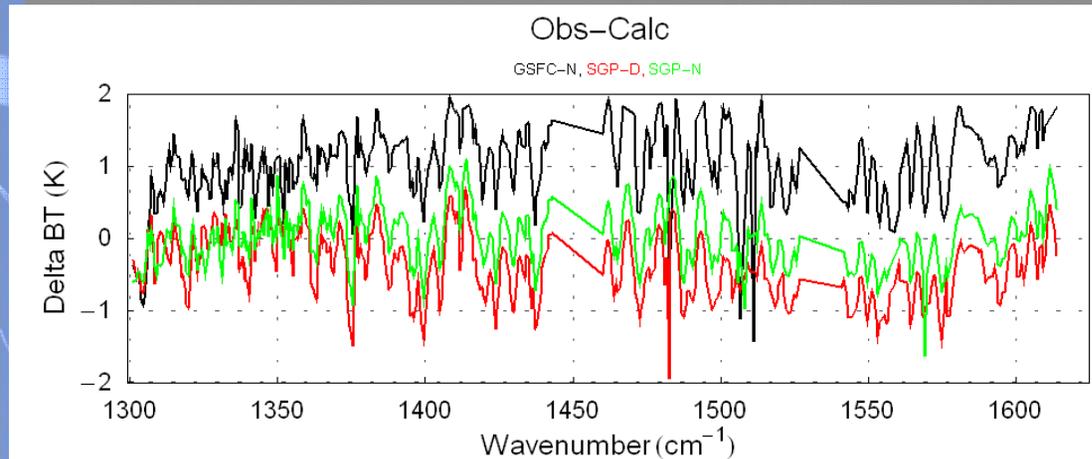
- June 26 – August 12, 2006
- 143 sondes including 15 CFHs, 35 ozonesondes and 7 technologies of PTU sensors (coordinated with overpasses)
- Coordinated operations with 7 lidar systems (5 Raman and 2 backscatter)
- 3 CALIPSO/HSRL overpasses
- Extended lidar/sonde operations during a 5-day heat wave/pollution outbreak period

- Analysis status

- Preliminary data being uploaded to AVDC
- Data QC in progress
 - WAVES ozonesonde QC being done simultaneously with SAUNA
 - Sonde/lidar/satellite intercomparisons in progress
 - RS92 ground check procedure
 - MWR GPS total column water reference
- Preliminary comparisons shown here

AIRS Water Vapor Experiment-Ground (AWEX-G)

- **Held at DOE/SGP in Oct-Nov, 2003**
 - Various water vapor measurement technologies
 - Sondes: Vaisala, Intermet, Sippican
 - Cryogenic Instruments: CFH, SnowWhite
 - Lidars: CARL, SRL
 - Total column: MWR, GPS
- **Results**
 - Validation of empirical correction for Vaisala RS80 and RS90/92
 - Validation of physical corrections to Raman lidar

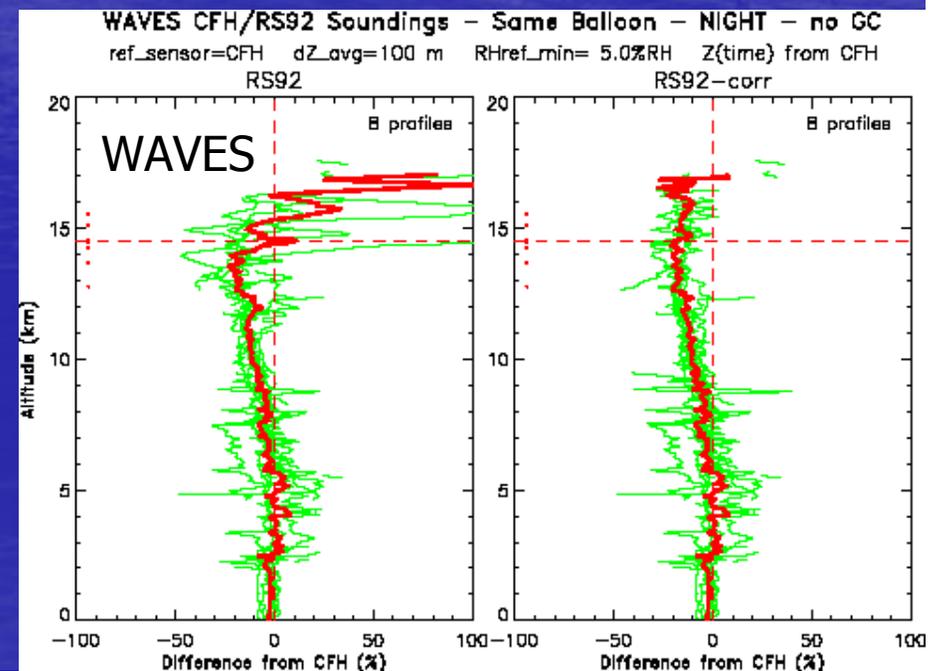
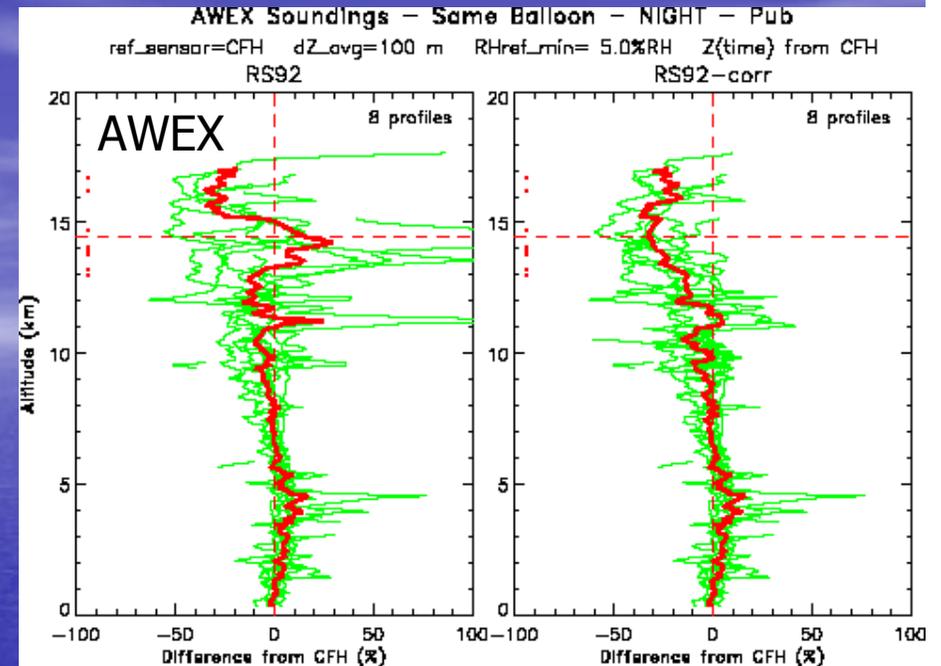


Miloshevich, L. M., et al. *J. Geophys. Res.*, 111, (2006).
Whiteman, D. N., et al., *J. Geophys. Res.*, 111, (2006).

RS-92 QC vs CFH

(Miloshevich, Bojkov, Lesht, Keenan, Forno, Whiteman)

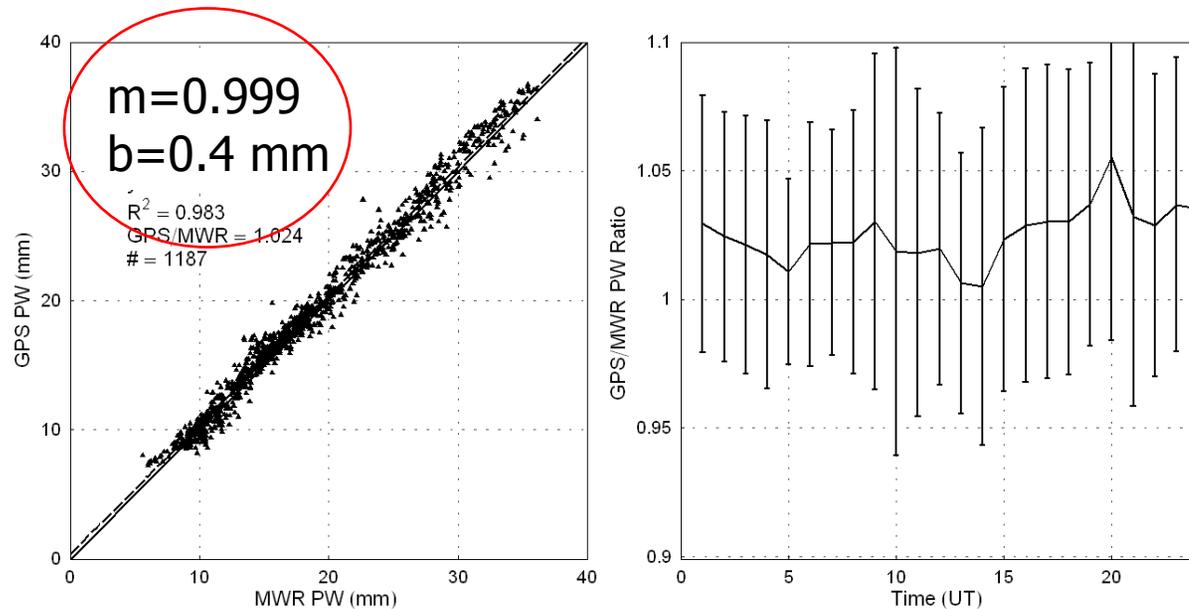
- RS-92 RH measurement QC
 - Removal of bad ground-check
 - Wet dessicant
 - Comparison with CFH
 - Not complete but initial comparisons of RS92 and CFH show similar behavior
 - Empirical correction for from WAVES may be similar to that from AWEX despite a change in RS92 calibration (?)



GPS MWR QC – Ljligren, Van Hove, Demoz, Nzeffe, Whiteman

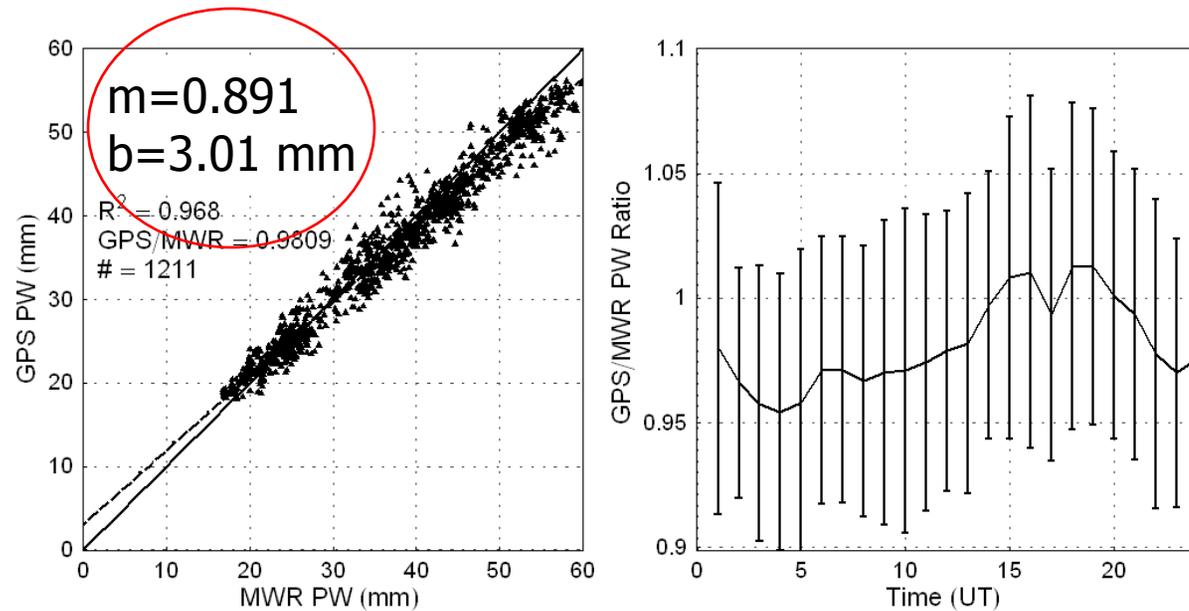
AWEX
(2003)

SuomiNet GPS
VS
ARM MWR (SGP)

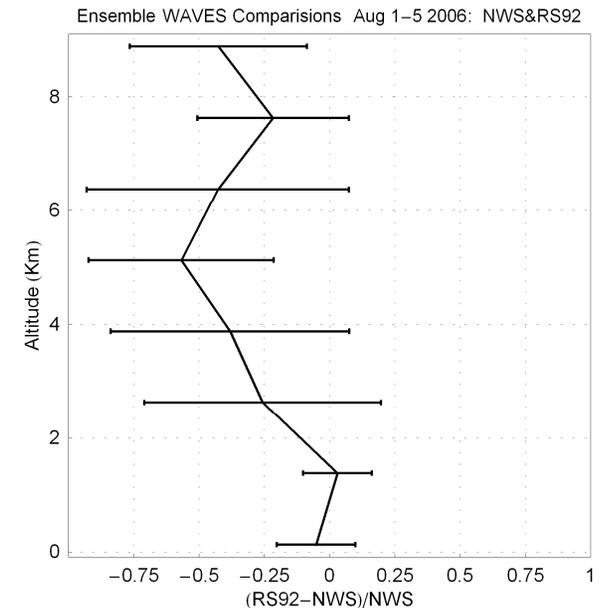
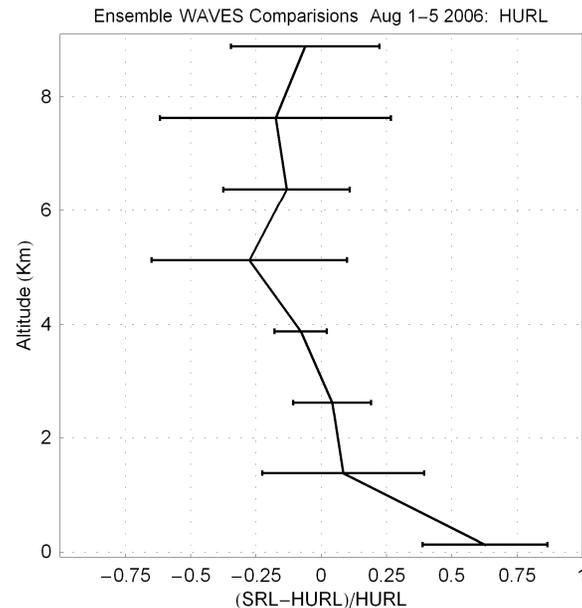
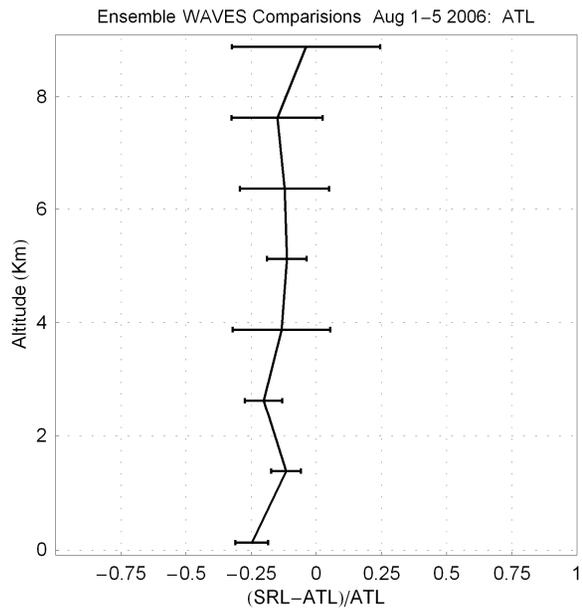
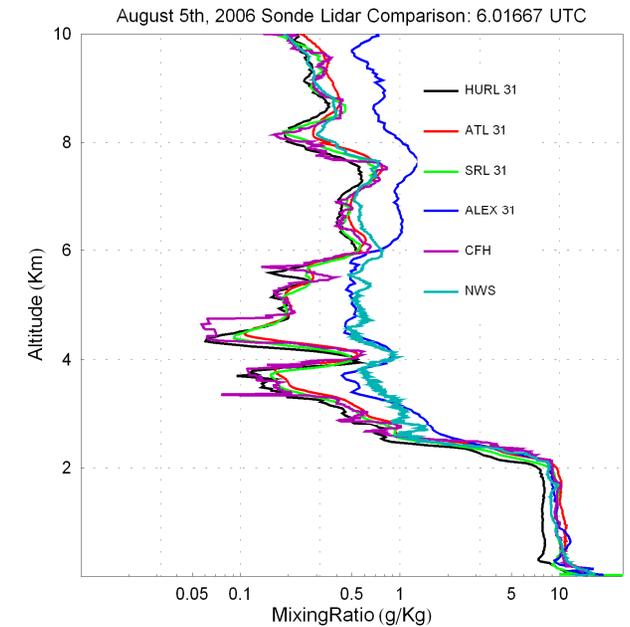
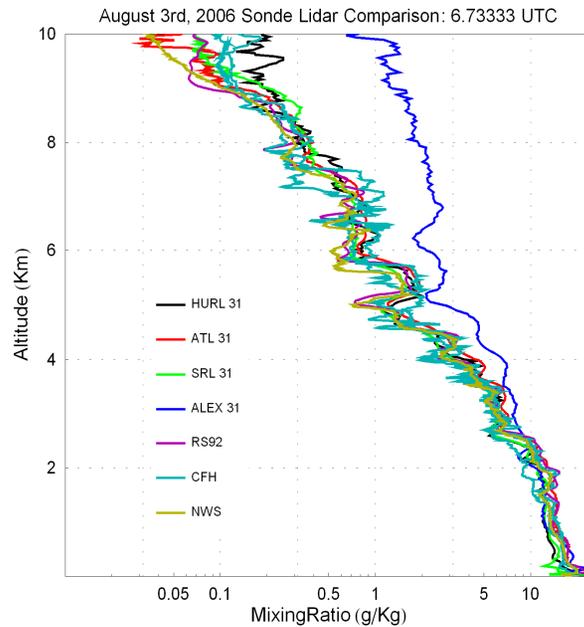
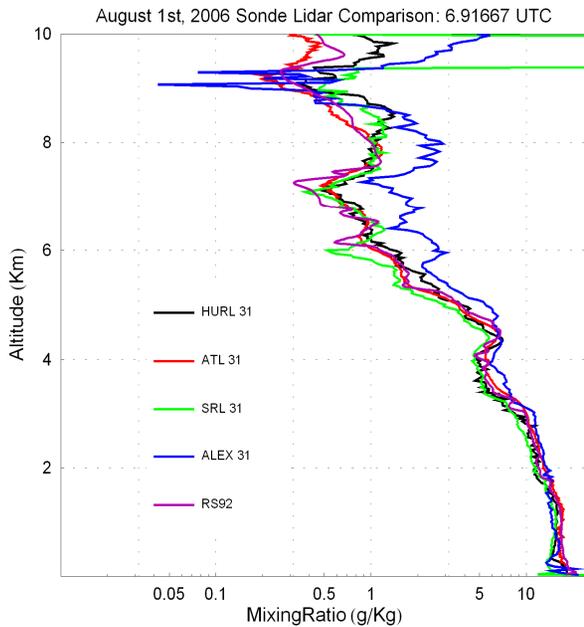


WAVES
(2006)

SuomiNet GPS
VS
HU MWR (BV)

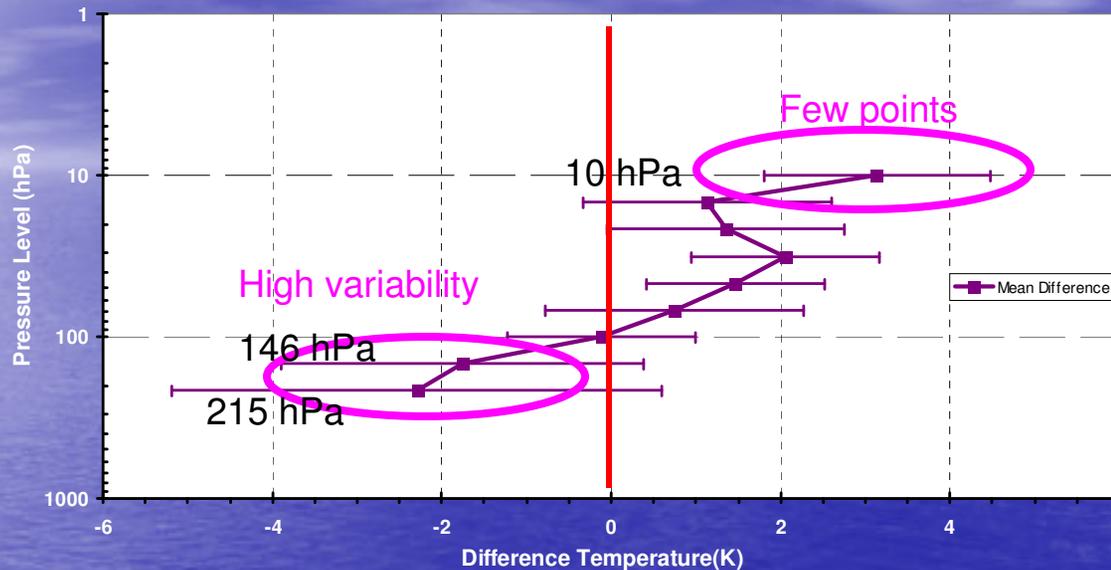


Multiple Lidar-Sonde Comparisons – Comer, SSAI

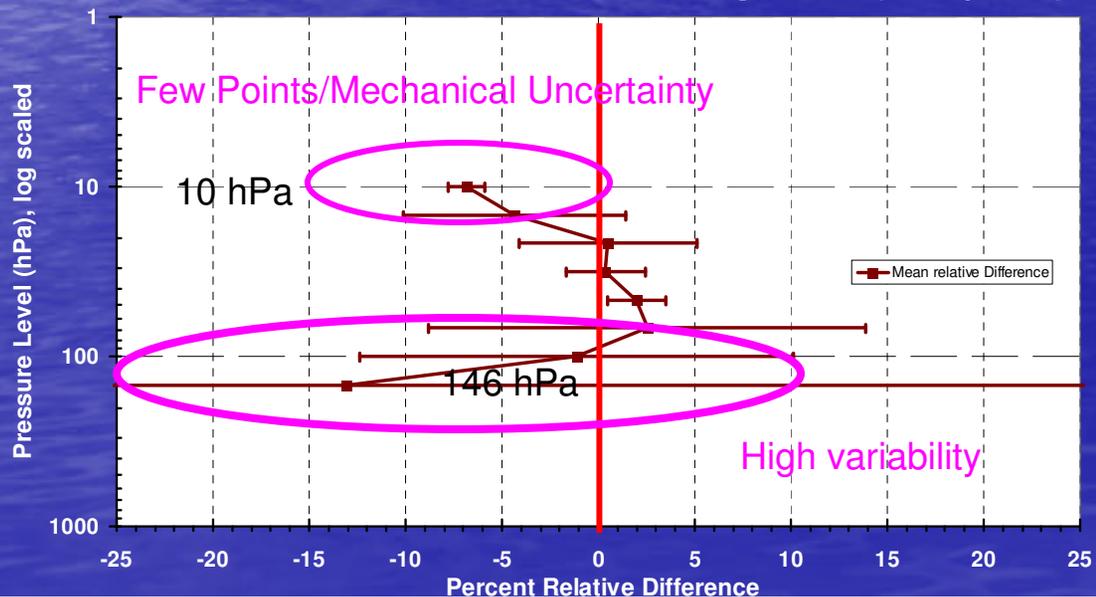


MLS-sonde T, O₃ differences (v1.5, box averages) (C. Stearns, B. Bojkov)

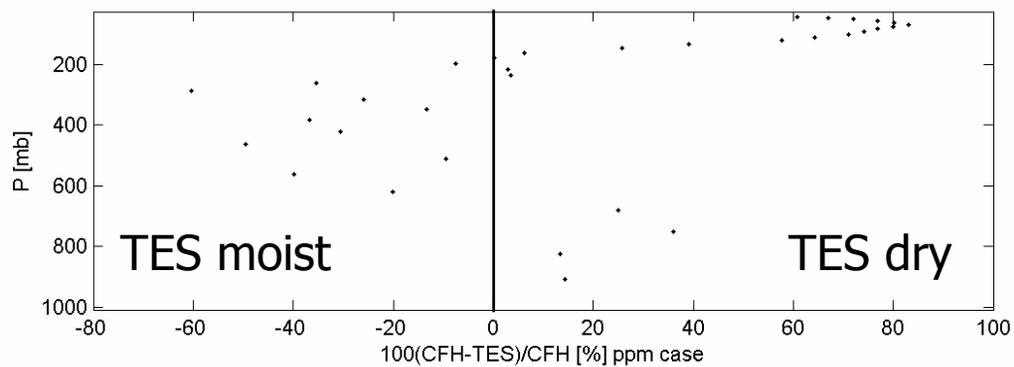
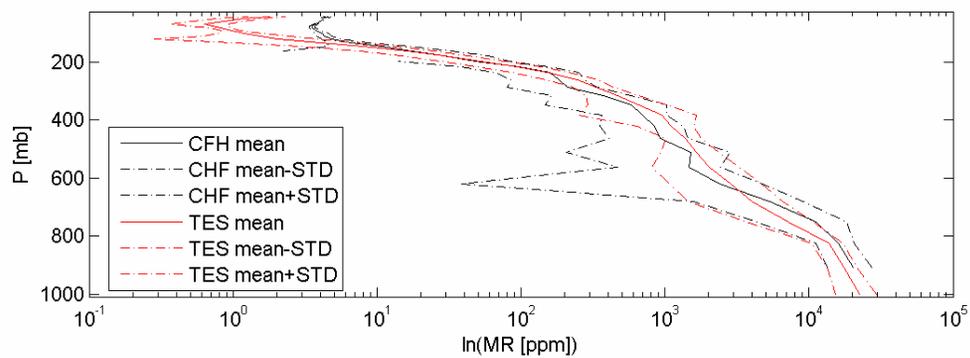
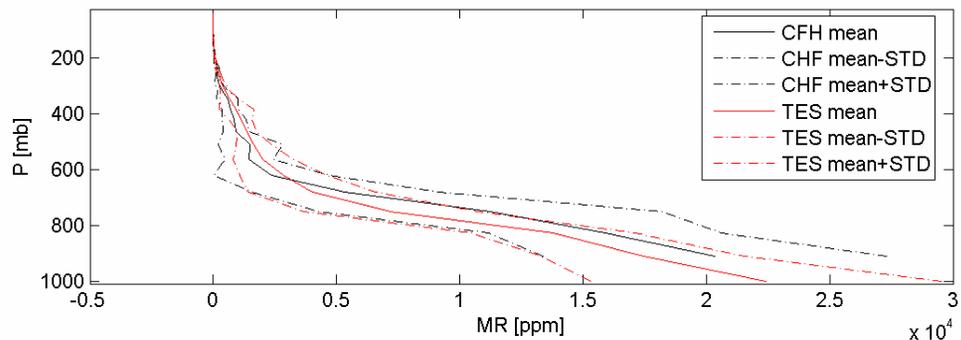
Mean Difference MLS-RS92 Box Average, Temperature (14 overpasses)



Mean Relative Difference MLS-RS92 Box Average, Ozone (6 overpasses)



TES – CFH Water Vapor Comparisons (box average) – Adam/HU



Air Quality?

Rabenhorst, UMCP

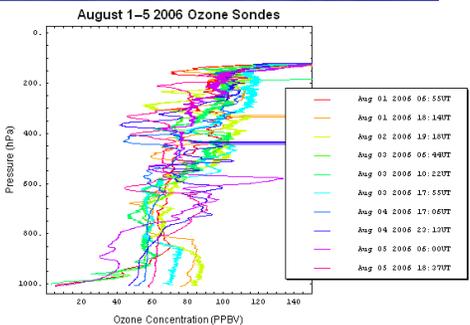
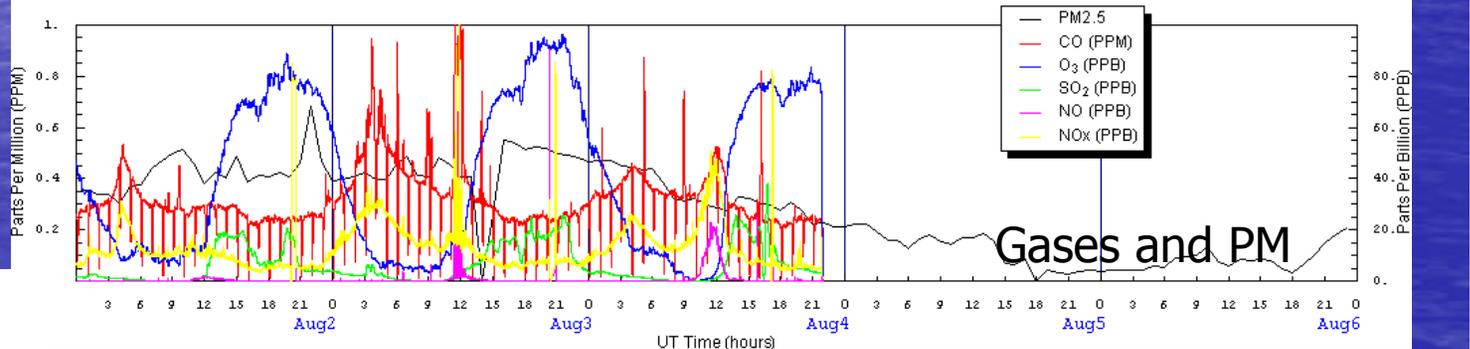
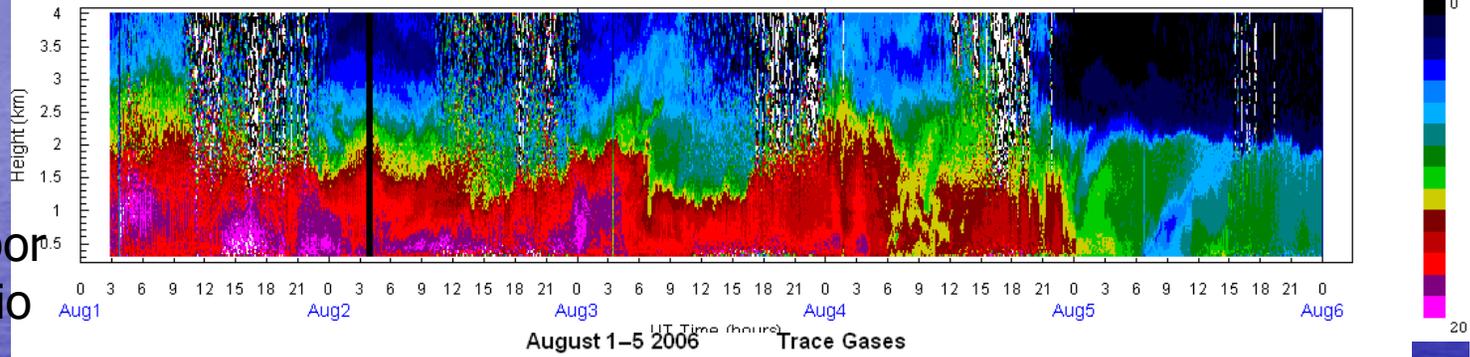
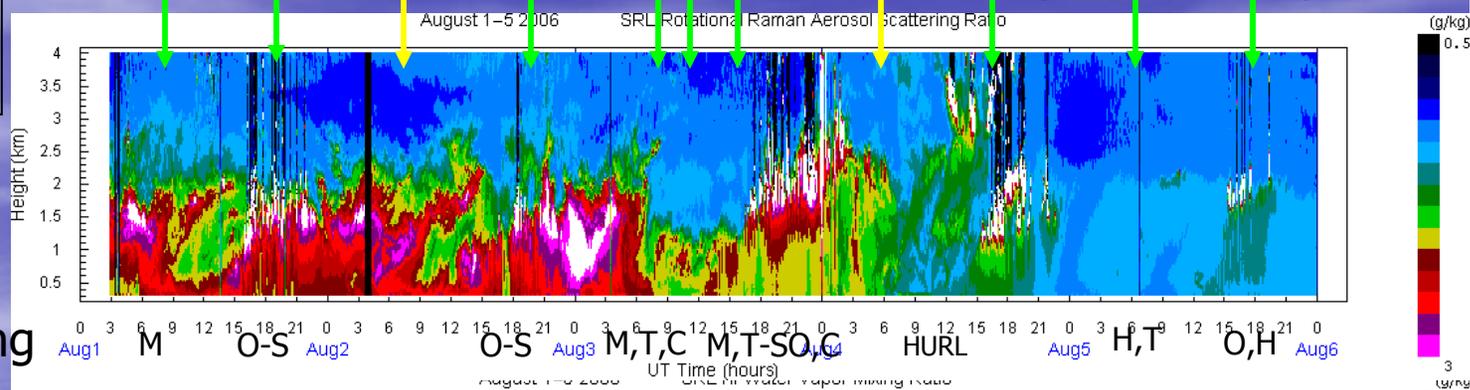


Aerosol scattering ratio

Water vapor Mixing ratio

Ozonesonde record

Arrows indicate times of sonde launches (O3 and PTU)



Five day sequence of lidar, ozonesonde, trace gas and PM measurements during a heat wave/pollution outbreak. PTU, PW and winds also available. Data such as these useful to couple ground and mid-troposphere.

What's next

- Continue QC
- Additional ozonesonde measurements this fall/winter
- Satellite comparisons using QC'd data
 - Use averaging kernels

- MOHAVE (LeBlanc)
 - ATL, SRL, CFH
 - water vapor profile comparisons at Table Mountain
- WAVES 2007

- Bi-weekly telecons – email me if you would like to participate

Questions?

